

**WE CLAIM:**

1. A compact electro-optical module for projecting on a display surface a two-dimensional image for viewing by a human eye, comprising:

- a) a support;
- b) a laser mounted on the support for emitting a laser beam;
- c) a first movable scan mirror mounted on the support and spaced

from the laser, for reflecting and for sweeping the laser beam from the laser at a first frequency over a first scan angle; and

d) a second movable scan mirror mounted on the support and spaced from the first movable scan mirror, for reflecting and for sweeping the laser beam reflected off the first movable scan mirror exteriorly of the module towards the display surface to produce an image thereon, said second scan mirror operating at a second frequency less than the first frequency, and sweeping over a second scan angle larger than the first scan angle.

2. The module of claim 1, and further comprising a stationary mirror mounted on the support for reflecting the beam from the first scan mirror to the second scan mirror.

3. The module of claim 1, and further comprising connector means on the support for enabling the module to be electrically connected to another support.

4. The module of claim 3, wherein the other support is a printed circuit board.

5. The module of claim 1, wherein the first and second frequencies are on the order of 10 kHz and 50 Hz, respectively; and wherein the first and second scan angles are on the order of  $\pm 7.2$  degrees mechanical and  $\pm 28.5$  degrees mechanical, respectively.

6. The module of claim 1, wherein the support is a generally rectangular parallelepiped and occupies a spatial volume on the order of 12mm x 10mm x 8mm.

7. The module of claim 1, further comprising a controller operative modulating the laser at selected positions of the sweeping laser beam so that light pixels on the display surface at a refresh rate so that the pixels persist to enable the eye to steadily view the image comprised of a light pattern of the pixels on the display surface.

8. The module of claim 3, wherein the connector means includes an analog video line for providing a video signal to the module to be processed by the module into a projected two dimensional video image.

9. The module of claim 1, further comprising a power source for energizing the laser and scan mirrors with no more than \_\_\_\_\_ current.

10. The module of claim 1, further comprising programmable processor for modulating the laser predetermined time intervals so that different still images formed from the light pixels on the display surface are periodically presented, wherein the duration of the time intervals may be set by the user.

11. An arrangement for displaying an image for viewing by a human eye, comprising:

- a) a housing having a screen which has a rear surface;
- b) an energizable laser supported by the housing for projecting a laser beam toward the rear surface of the screen when energized;
- c) a scanner supported by the housing for sweeping the laser beam along a plurality of light paths over the rear surface of the screen; and
- d) a controller supported by the housing and operatively connected to, and operative for energizing, the laser at selected positions of the laser beam in at least one of the light paths to generate individual light pixels at the selected positions, and at a refresh rate at which the pixels persist to enable the eye to steadily view the image comprised of a light pattern of the pixels on the screen.

12. The arrangement of claim 11, wherein the scanner includes a first scan mirror for sweeping the laser beam along a first direction along said at least one of the light paths, and a second scan mirror for sweeping the laser beam along a second direction generally orthogonal to the first direction, and wherein the controller is operative for energizing and de-energizing the laser as the laser beam is swept along a plurality of each of the light paths.

13. The arrangement of claim 11, wherein the housing has a size and a shape configured to be held in a user's hand.

14. The arrangement of claim 11, wherein the screen has an optically diffusive property and is movable to a deployed position in which the swept light beam is incident on the

rear surface of the screen and is diffused through the screen to render the image visible on a front surface of the screen.

15. The arrangement of claim 12, wherein the first scan mirror is moved at a first rate of speed through a first angular distance, and wherein the second scan mirror is moved at a second rate of speed slower than said first speed, and through a second angular distance greater than said first angular distance.

16. The arrangement of claim 12, and further comprising a fold mirror in an optical path of the light beam between the first and second scan mirrors.

17. The arrangement of claim 11, wherein the controller is operatively connected to a memory having stored fonts and timing data as to when to energize and de-energize the laser to display the image as font characters.

18. The arrangement of claim 11, and further comprising a non-laser light source for illuminating the rear surface of the screen.

19. The arrangement of claim 11, and further comprising a transceiver for transmitting and receiving data by wireless transmission to a remote host.

20. The arrangement of claim 11, and further comprising a keyboard for entering data, and wherein the display includes a plurality of display areas.

21. The arrangement of claim 11; and further comprising a stylus having a retro-reflector impinged by the light beam.

22. The arrangement of claim 22, wherein the stylus is configured to fit around a fingertip.

23. The arrangement of claim 11; and further comprising a single scan mirror, and wherein the scanner is operative for moving the scan mirror along a plurality of directions.

24. The arrangement of claim 11, wherein the light pattern constitutes a generally rectangular display.

25. The arrangement of claim 11; and further comprising a plurality of additional energizable lasers of the same wavelength as the first-mentioned laser, for increasing the number of the light pixels without having to increase the rate at which the scanner sweeps the respective laser beams.

26. The arrangement of claim 11, wherein the screen has an optical filter characteristic for blocking ambient light but transmitting the laser beam in order to enhance image contrast on the screen.

27. The arrangement of claim 11, wherein the controller is operative for changing a size of the light pattern as a function of screen position so as to adapt image size to screen size.

28. The arrangement of claim 11; and further comprising a sensing element for sensing ambient light to provide brightness adjustment on the screen.

29. The arrangement of claim 11, wherein the controller is operative for energizing the laser at selected positions of the laser beam to generate individual light pixels depicting a cursor that is movable across the light pattern.

30. The arrangement of claim 11, wherein the laser, the scanner and the controller are mounted on a common support to constitute a module.

31. The arrangement of claim 30, wherein the screen is larger in area than the module.

32. A method of displaying an image for viewing by a human eye, comprising the steps of:

a) mounting a screen having a front surface and a rear surface on a housing;

b) providing an energizable laser on the housing to project a laser beam toward the rear surface of the screen;

c) sweeping the laser beam along a plurality of light paths over the rear surface of the screen; and

d) energizing the laser at selected positions of the laser beam in at least one of the light paths to generate individual light pixels at the selected positions, and at a refresh rate at which the pixels persist to enable the eye to steadily view the image comprised of a light pattern of the pixels on the front surface of the screen.

33. The method of claim 32, wherein the sweeping step is performed by sweeping the laser beam along two mutually orthogonal directions.

34. A user supported, personal pocket appliance for displaying information, comprising:

a) a housing having a display panel;

b) an energizable laser in the housing for projecting a laser beam toward of the display panel when energized;

c) a scanner in the housing for sweeping the laser beam along a plurality of light paths over the surface of the display panel; and

d) a controller in the housing operatively connected to, and operative for energizing, the laser at selected positions of the laser beam in at least one of the light paths to generate individual light pixels at the selected positions on the display panel, and at a refresh rate at which the pixels persist to enable a human eye to steadily view the image comprised of a light pattern of the pixels on the front surface of the display panel.

35. The device of claim 34, wherein the display panel is mounted for movement on the housing between an inactive position and a display position.

36. The device of claim 34, wherein the housing has three housing sections, each pivotably connected to one another in a clamshell mounting, the display panel forming one of the housing sections when in a viewing position.

37. An arrangement for displaying an image for viewing by a human eye, comprising:

- a) a screen;
- b) an energizable laser for projecting a laser beam toward the screen when energized;
- c) a scanner for sweeping the laser beam along a plurality of light paths over the screen;
- d) a controller operatively connected to, and operative for energizing, the laser at selected positions of the laser beam in at least one of the light paths to generate

individual light pixels at the selected positions, and at a refresh rate at which the pixels persist to enable the eye to steadily view the image comprised of a light pattern of the pixels on the screen; and

e) means for compensating for distortion in the light pattern.

38. An arrangement for displaying an image for viewing by a human eye, comprising:

a) a screen;

b) an energizable laser for projecting a laser beam toward the screen

when energized;

c) a scanner for sweeping the laser beam along a plurality of light paths over the screen;

d) a controller operatively connected to, and operative for energizing, the laser at selected positions of the laser beam in at least one of the light paths to generate individual light pixels at the selected positions, and at a refresh rate at which the pixels persist to enable the eye to steadily view the image comprised of a light pattern of the pixels on the screen; and

e) means for compensating for brightness across the light pattern.

39. An arrangement for displaying an image for viewing by a human eye, comprising:

a) a housing having a screen;



b) an energizable laser for projecting a laser beam toward the screen when energized;

c) a scanner including an array of miniature micromachined mirrors for sweeping the laser beam along a plurality of light paths over the screen; and

d) a controller operatively connected to, and operative for energizing, the laser at selected positions of the laser beam in at least one of the light paths to generate individual light pixels at the selected positions, and at a refresh rate at which the pixels persist to enable the eye to steadily view the image comprised of a light pattern of the pixels on the screen.

40. An arrangement for electro-optically reading indicia, and for displaying an image for viewing by a human eye, comprising:

a) a hand-held housing; and

b) a battery-powered module supported by the housing, the module including an energizable laser for emitting a laser beam, a scanner for sweeping the laser beam, and a controller operatively connected to, and operative for energizing, the laser in a reading mode in which the laser beam is swept across the indicia, and in a display mode in which the laser beam is projected onto a display surface as individual light pixels at a refresh rate at which the pixels persist to enable the eye to steadily view the image comprised of a light pattern on a display surface.

41. The arrangement of claim 40, and further comprising an actuator for manually selecting one of the modes.

42. The arrangement of claim 40, wherein the controller is operative for simultaneously sweeping the laser beam across the indicia and for projecting the image on the display surface.

43. A laser scanner for either displaying an image or reading indicia by effecting a scanning motion of a light spot beam in an x-axis direction across a target surface, said scanner comprising:

- (a) at least two semiconductor laser disposed adjacent to one another, each laser capable of producing a light beam of generally circularly-symmetric cross-section;
- (b) means for selectively simultaneously activating said two adjacent lasers for producing a single beam spot which is generally elongated in the direction of the x-axis, or the y-axis; or at an angle between the x-axis and y-axis.

44. A scanner as defined in claim 42, wherein each of said lasers is a VCSEL disposed on a common semiconductor substrate.

45. A laser scanner comprising an array of VCSEL laser disposed on a substrate, the array including a plurality of columns of individual lasers which are staggered with respect to each adjacent column.

46. A scanner as defined in claim 45, wherein a column of individual lasers is disabled if a laser in such column is defective.